Science Societies

Microbial oxygen consumption is influenced by soil pore structure

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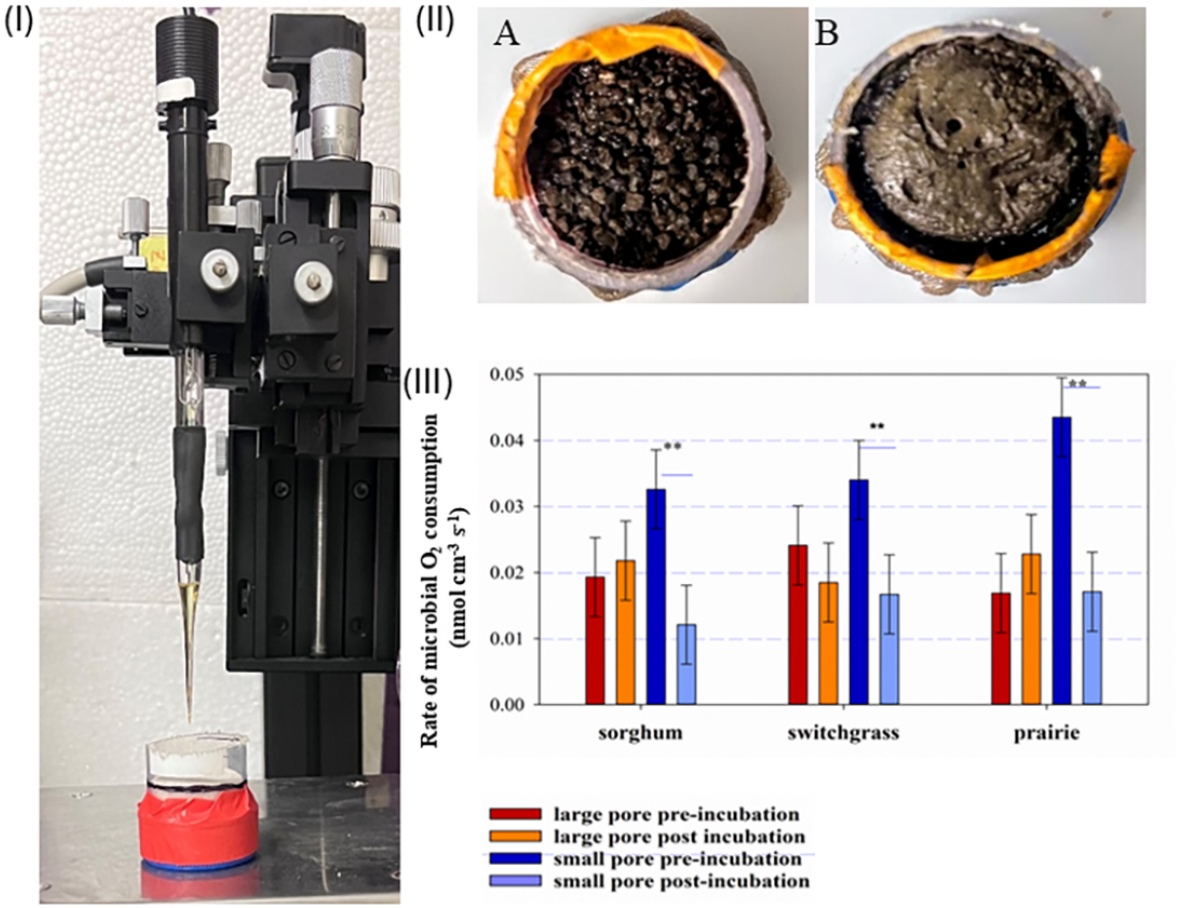

(I) A micro-profiling system with an O2 microsensor; (II) A: large pore soil material, B: small pore soil material; and (III) calculated rates of volumetric O2 by microbes before and after 38 days incubation. Image by Poulamee Chakraborty, GLBRC, Michigan State University.

Since heterotrophic soil microbes use oxygen (O_2) as an electron acceptor, microscale O_2 availability influences microbial contributions to soil carbon and nitrogen cycles. The soil O_2 availability is determined by the O_2 diffusion from the atmosphere and microbial O_2 consumption in the soil. Pore structure is a well understood driver of O_2 diffusion. But does pore structure also affect microbial O_2 consumption?

To answer this question, researchers from the Great Lake Bioenergy Research Center at Michigan State University collected soil from three bioenergy cropping systems to create soil environments with two contrasting pore structures, i.e., large vs. small soil pores, of >30 µm and <10 µm diameters, respectively. They used O_2 microsensors to measure O_2 profiles and calculated microbial O_2 consumption using the finite difference method for solving Fick's Second Law of Diffusion at a steady state.

The researchers found that microbial O_2 consumption is indeed impacted by the pore structure. In the large-pore soil, O_2 consumption was stable while it rapidly decreased in the small-pore soil after 38 days of incubation. The study suggests that large-pore soil provides a better physical microenvironment for soil microbes while the O_2 limitation in small-pore soil might, in the long-term, contribute to changes in their

metabolism.

Dig deeper

Chakraborty, P., Guber, A., & Kravchenko, A. (2025). Microbial O_2 consumption as a function of pore structure in soils of sorghum, switchgrass, and prairie vegetation systems. *Vadose Zone Journal*, *24*, e70001. https://doi.org/10.1002/vzj2.70001

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